

**AIR QUALITY IMPACT ASSESSMENT
FERMA - CARDEN QUARRY
FERMA CRUSHED STONE INC.**

JOB: 92-8977

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1.0 INTRODUCTION

Ferma Crushed Stone Inc. is proposing a quarry development on Lots 7, 8, 9, and Part of Lots 6 and 10, Concession IX, Carden Township in Victoria County (refer to Figure 1).

This air quality impact assessment of quarry development is based a review of; Ministry of Environment and Energy's (MOEE) guidelines for approval of quarry operations under the Environmental Protection Act, site locality and surrounding land use, wind climate, operation plans, and air pollutant emission factors published by the United States Environmental Protection Agency (U.S. EPA). Further, this assessment has been prepared in support of applications for an amendment to the Carden Township Official Plan, and Quarry License under the Aggregate Resources Act.

The principal air pollutant emitted by quarry operations consist of dust. Sources of dust include, drilling, blasting, transporting blasted material to the primary crusher, crushing (primary and secondary), screening, conveying, stockpiling, loading of trucks, truck traffic, and wind erosion.

Recommendations of this report are to be incorporated by the Operational Plans to mitigate dust emissions. Prior to installing processing equipment it will be necessary to obtain a Certificate of Approval from the Ministry of Environment and Energy in compliance with Regulation 346 of the Environmental Protection Act.



3.0 SITE LOCATION AND SURROUNDING LAND USE

The site location is shown on Figures 1 and 2. Figure 2 identifies the limits of the quarry property, the proposed limits of extraction within same, and surrounding residences/land use.

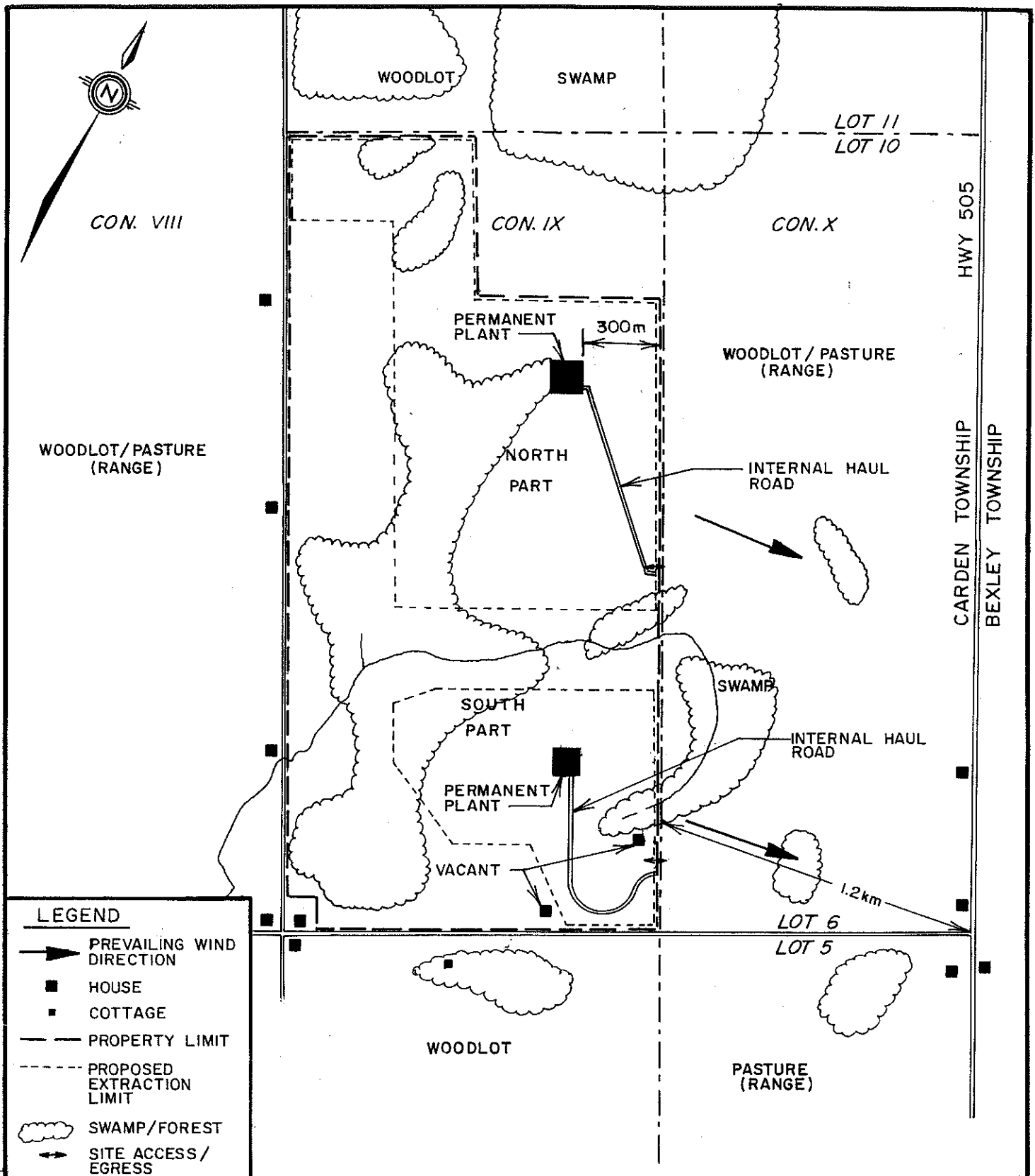
The site is bounded on the south by Carden Line 5/6, on the west by Concession IX, on the north by Carden Line 10/11 and on the east by Concession X. Carden Line 10/11, and Concession X are presently unopened road allowances.

The nearest residences are located to the south and west fronting onto Carden Line 5/6 and Concession IX, a minimum of 400 metres from the proposed limits of extraction.

To the east, the closest residence is 1.2 kilometres from the south portion of the site. Lands east of the mid and north portions of the site, and north of the site, are uninhabited.

Surrounding land uses are generally open pasture and swamp/woodlot.





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DATE AUG., 1994	CLIENT FERMA - CARDEN QUARRY	DWG. No. 92 - 8977-AQ
SCALE 1 : 20000	TITLE PREVAILING WINDS	FIG. 2

Strong winds generally come from the southwest and west. There are no residences located within two kilometres down wind of the southwest direction.



The limestone will be drilled and blasted, and transported to the portable plant processing area by front end loader. Off-road haul trucks will be used to transport blast rock from the active face to the permanent plant processing area.

The processing plant will consist of a primary rock jaw crusher, a secondary cone crusher, and screens. Conveyors will be used to transport material from the initial stages of processing to stockpiles.

Stockpiles will be located in the general vicinity of the processing area and will be 10 to 20 m in height. They will consist of clear stone of various gradations and granular screenings.

Stockpiled material will then be loaded onto haulage vehicles by front end loader for off-site delivery.

A schematic of material processing is shown on Figure 3.

Haulage vehicles will access the site from a road to be constructed within the unopened road allowance between Concessions IX and X. This road surface will be treated with asphalt, or surface treatment.

The ultimate annual extraction rate is projected to be 1,000,000 tonnes per year, or 330 tonnes per hour, assuming 250 operating days, and 12 hours of operation each day.



6.0 AIR QUALITY IMPACTS

6.1 Emission Sources

Dust emissions are categorized as process or fugitive emissions. Process dust sources are associated with those which may be captured during material processing. Fugitive sources involve the repeated disturbance of settled dust particles where capture is impracticable. Potential emission sources are categorized as follows:

Process Sources: Drilling/blasting, crushing, screening and conveying.

Fugitive Sources: Loading/unloading, vehicular movement, stock pile formation, wind erosion.

The US EPA has developed emission factors for process sources based on observation data, and formula for estimating dust emission concentrations from fugitive sources.

Appendix "A" is a summary of emission rates from proposed quarry operations, which are summarized in Table 3.

TABLE 3

SUMMARY OF EMISSION RATES (kg/hr)

Source		Total Emissions	
		Dry	Wet
Portable Plant	Process	69.7	1.8
	Fugitive	6.8	3.5
	Total	76.5	5.3
Permanent Plant	Process	69.7	1.8
	Fugitive	7.2	3.6
	Total	76.9	5.4
Internal Haul Roads	per 100 m	5.4	1.4



TABLE 4
PREDICTED DOWNWIND PARTICULATE/DUST CONCENTRATIONS
FOR PLANT AREA WITH DUST SUPPRESSION

Criteria	Point of Impingement Distance from Plant (m)					AAQC
	100	200	300	400	500	
Total Dustfall* (g/m²)						
A) 30 Day	12.6	8.2	6.3	5.3	4.6	7
* atmospheric stability category 'C' including background concentration of 3.0 g/m ²						
Total Suspended Particulate (µg/m³)						
A) ½ Hour Average**	220	149	105	77	59	100
B) 24 hr*	158	102	77	64	56	120
C) Annual*	52	50	41	39	38	60
* atmospheric stability category 'C' including background concentration of 35 µg/m ³						
** atmospheric stability category 'D'						

MOEE AAQC objectives for hourly TSP would be met at a distance of approximately 300 metres from the plant location assuming a total emission rate of 5.4 kg/hr. For a permanent plant, this objective would be met at the easterly property limit directly downwind of the plant area. During the period a portable plant is utilized, and located a minimum of 100 metres inside the easterly property limit, the AAQC objectives would be achieved between 200 and 300 metres east of the easterly property limit.

The highest off-site concentration of fugitive dust emissions produced by haulage vehicles will occur adjacent to proposed access/egress points on the easterly boundary of the quarry site.



7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the forgoing analysis, the following conclusions and recommendations are made:

7.1 Plant Area Dust Controls

Provided dust suppressants are used for material processing, and on haul roads in the vicinity of the processing and stockpiling area, permanent plant related quarry activities will meet MOEE AAQC objectives at the easterly property line.

Although temporary, during the initial start-up of the southerly and northerly parts of the quarry, dust emissions will exceed AAQC objectives at the easterly property line, but will meet same within 300 metres of the property limit. The lands affected are uninhabited and consist of scrub pasture, swamp and woodlot.

The above limits of impingement are based on using water sprays at crushing, and conveyor transfer points to achieve a material moisture content of 1.5%. In addition, water should be applied during periods of dry weather at 1 L/m² to all areas of vehicular travel once every eight hours minimum to obtain a 75% reduction in dust emissions.

Reductions in dust concentrations due to gravitational settling have not been taken into consideration. If considered, predicted concentrations values would be reduced.

7.2 Internal Haul Roads

All internal haul routes outside of the plant area should be constructed of crushed limestone and wetted as noted above. Other dust suppressants such as



8.0 REFERENCES

Environment Canada, Atmospheric Environment Service, Climatic Normals.

F.H. Schaedlich Consulting Ltd, Ontario Ministry of Environment, Regulation 308 Dispersion Programs Addendum - Version 2.0, August 1989.

Ontario Ministry of Environment, Approvals Branch, Guidelines for the Approval of Pit & Quarry Operations Under the Environmental Protection Act, February 1990.

Ontario Ministry of Environment, Air Resources Branch, Summary of Point of Impingement Standards, Ambient Air Quality Criteria (AAQCs) and Approvals Screening Levels (ASLs), August 1991.

Ontario Ministry of Environment, Air Quality in Ontario - 1992.

US EPA, AP-42, Computation of Air Pollutant Emission Factors; Fugitive Dust Sources, Section 11.2, 1985.

US EPA, AP-42, Computation of Air Pollutant Emission Factors; Revised Section 8.19.2 Crushed Stone Processing, (unpublished, available on US EPA bulletin board), April 1994.



APPENDIX "A"

*DUST EMISSION RATES
AIR QUALITY IMPACT ASSESSMENT
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APPENDIX "A"

DUST EMISSION RATES AIR QUALITY IMPACT ASSESSMENT FERMA - CARDEN QUARRY FERMA CRUSHED STONE INC.

A1.0 OPERATING DETAILS/EMISSION FACTOR PARAMETERS

The following is a summary of data relating to proposed quarry operations which are considered in estimating dust emissions:

Processing

Annual production rate	= 1,000,000 tonnes/yr
Days of material processing	= 275 days/year
Days of material haulage	= 250 days/year
Average hours of operation	= 12 hrs/day
Average hourly production rate (Q_p)	= 303 tonnes/hr
Average hourly haul rate (Q_h)	= 330 tonnes/hr
Percentage of material passing secondary processing	= 50%
Plant area (A)	= 1 ha

Haul Truck Activity

Truck capacity	= 38 tonnes
Empty truck weight	= 15 tonnes
Mean truck weight (W)	= 34 tonnes
Average no. of round trips per hour	= 8.7
Haul distance on plant road	= 0.1 km
Kilometres travelled per hour on plant road (KTV)	= 1.7 km(trav)/hr
Average haul road distance (plant to site entrance)	= 0.8 km
Kilometres travelled per hour on haul road (KTV)	= 13.9 km(trav)/hr
Average speed on plant road(s)	= 5 km/hr



A2.0 EMISSION FACTORS

There are two scenarios which may be examined from an operating perspective. During initial opening of both parts of the quarry, it is proposed that a portable processing plant be employed until extraction is established approximately 300 m to 400 metres from the westerly boundary of the site. Once this area is opened, a permanent plant will be established in a central location in each part.

Fugitive emissions are also identified as being plant related, or haul route related. This is primarily due to the fact that internal haul road emissions are spread over a larger area, and will disburse more readily than emissions from plant activity.

The following are emission estimates for each scenario.

A2.1 Portable and Permanent Plant Process Emissions

TABLE A1
US EPA
PROCESS EMISSION SOURCES

Process	Emission Factors (kg/tonne)			
	% Material	Dry	Wet	US EPA Rating
Drilling/Blasting	100	data unavailable		
Crushing	100	0.0003	0.0003 (assumed)	E
Screening	100	0.073	0.0042	D
Secondary Crushing	50	0.018	0.0007	D
Secondary Screening	50	0.15	0.0018	D
Conveyor Transfer	3 @ 100	0.018	0.00006	D
Points	2 @ 50	0.018	0.00006	D
Overall		0.23	0.006	D

Note: Dry < 1.5% moisture content
Wet ≥ 1.5% moisture content

Total process emission sources $E_p \text{ (Dry)} = 0.23(303) = 69.7 \text{ kg/hr}$
 $E_p \text{ (Wet)} = 0.006(303) = 1.8 \text{ kg/hr}$



trucks. (For simplicity, emission factors for off-road haulage vehicles in the processing area are assumed to equal that produced within same by off-site haul vehicles.)

Permanent plant fugitive dust emissions are estimated to be:

$$\begin{aligned} \text{Epf} &= \text{Epf} + \text{Epr} - \text{El} \\ &= 7.2 \text{ kg/hr (dry)} \\ &= 3.6 \text{ kg/hr (wet)} \end{aligned}$$

A2.4 Haul Road Fugitive Emissions

The haul road distance between the site entrance and plant location will be approximately 800 m for both parts of the quarry, and surfaced with crushed limestone. The estimated emissions over this 800 m distance are:

$$\begin{aligned} \text{Ehr} &= 43 \text{ kg/hr (dry) or } 5.4 \text{ kg/hr/100 m} \\ &= 10.75 \text{ kg/hr (wet) or } 1.35 \text{ kg/hr/100 m} \end{aligned}$$

Once a permanent plant is established, an internal haul road will be constructed from the plant to the active face. This road will also be surfaced with crushed limestone, however, off-road vehicle haul roads will be a minimum 500 m from the easterly property boundary, except at the extreme northwest corner of the site.



APPENDIX "B"

*DOWNWIND DUST CONCENTRATIONS
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APPENDIX "B"

DOWNWIND DUST CONCENTRATIONS AIR QUALITY IMPACT ASSESSMENT FERMA - CARDEN QUARRY FERMA CRUSHED STONE INC.

B1.0 DISPERSION MODELLING

B1.1 Hourly Particulate Concentrations

Initial modelling of dust emissions determined that MOEE objectives for air quality cannot be met within a reasonable distance downwind of quarry operations without employing dust suppressants during processing, and to control fugitive dust emissions.

Table B1 are estimated point concentrations of dust particulate downwind of respective quarry activities (plant operations and on-site haul route activity).

To achieve the MOEE air quality objective for particulate concentrations of $100 \mu\text{g}/\text{m}^3$ at the easterly property limit, the permanent plant area should be located a minimum of 350 m from same. This calculation does not take into consideration the settling of dust particles, if considered, concentration values would be reduced.

During the initial years of operations when a portable plant is employed and located 100 m from the easterly property line, the point of impingement at which MOEE air quality objectives are realized (including ambient concentrations) will be less than 300 m downwind of the easterly property limit adjacent to the plant.



TABLE B1
FERMA - CARDEN QUARRY
DOWNWIND DUST CONCENTRATION AT POINTS
(MODEL VERSION 2.00)

FERMA - CARDEN QUARRY - DOWNWIND DUST CONC. FROM PLANT AREA

Virtual Sources							
Number	Height (m)	Emission Rate* (g/s)	Width (m)	Length (m)	Angle (deg)	X (m)	Y (m)
1.0	10.0	1.5*	100.0	100.0	0.0	1.0	1.0
Points of Impingement							
Number (m)	X (m)	Y (m)	Z (m)	Type	Description		
1	100.0	0.0	0.0	closed			
2	200.0	0.0	0.0	closed			
3	300.0	0.0	0.0	closed			
4	400.0	0.0	0.0	closed			
5	500.0	0.0	0.0	closed			
6	600.0	0.0	0.0	closed			
7	700.0	0.0	0.0	closed			
8	800.0	0.0	0.0	closed			
9	1000.0	0.0	0.0	closed			

* Total Emissions Portable Plant E = 5.3 kg/hr (wet)
Total Emissions Permanent Plant E = 5.4 kg/hr (wet)
Use E = 5.4 kg/hr = 1.5 g/s



TABLE B1 (CONT'D)

FERMA - CARDEN QUARRY - DOWNWIND DUST CONC.

ON-SITE HAUL ROAD WITH WINDS BLOWING PARALLEL

Virtual Sources							
Number	Height (m)	Emission Rate (g/s)	Width (m)	Length (m)	Angle (deg)	X (m)	Y (m)
1	3.0	0.40	100.0	10.0	90.0	0.0	0.0

Point of Impingement			Stability	Concentration ($\mu\text{g}/\text{m}^3$)	Wind Direction	Conditions Speed (m/s)	Height (m)
X (m)	Y (m)	Z (m)					
100.0	0.0	0.0	C	122.87	0.0	5.000	0.0
			D	341.47	0.0	5.000	0.0
200.0	0.0	0.0	C	40.043	0.0	5.000	0.0
			D	124.83	0.0	5.000	0.0
300.0	0.0	0.0	C	19.989	0.0	5.000	0.0
			D	65.509	0.0	5.000	0.0
400.0	0.0	0.0	C	12.076	0.0	5.000	0.0
			D	40.783	0.0	5.000	0.0
500.0	0.0	0.0	C	8.1303	0.0	5.000	0.0
			D	28.040	0.0	5.000	0.0



B1.2 24 Hour/30 Day/Annual Concentrations

Under average conditions, ie. winds less than 20 m/s, the 24 hr particulate concentration will equal that resulting from quarry activities over 12 hrs/day of operations. The following equation is used to estimate 24 hr suspended particulate generated by quarry plant operations:

$$C_{24} = C_{\text{plant}}(12/24)(2) + C_{\text{wind}}(H_w/24)$$

Where: C_{plant} = 1/2 hour average concentration provided by Table B1 (atmospheric stability 'C')
 C_{wind} = 0 for winds < 20 m/s under average conditions.

24 hr and 30 day concentrations are summarized in Tables B2 and B3 respectively.

TABLE B2
24 HOUR SUSPENDED PARTICULATE ($\mu\text{g}/\text{m}^3$)

Source	Distance from Plant (m)				
	100	200	300	400	500
Plant	123	67	42	29	21
Ambient	35	35	35	35	35
Total	158	102	77	64	56

MOEE AAQC = $120 \mu\text{g}/\text{m}^3$



TABLE B4
ANNUAL SUSPENDED PARTICULATE ($\mu\text{g}/\text{m}^3$)

Source	Distance from Plant (m)				
	100	200	300	400	500
Plant	16	9	6	4	3
Ambient	35	35	35	35	35
Total	51	44	41	39	38

MOEE AAQC = $60 \mu\text{g}/\text{m}^3$

- Notes: 1) A gravitational settling rate of 0.03 m/s for dust particles is used to estimate monthly and annual dustfall from 24 hr suspended dust emissions from quarry operations.
- 2) Ambient particulate concentrations are average 1992 arithmetic means recorded at the closest monitoring stations: Nos. 45073 & 45074 at Hwy 7/12 in Sunderland; Nos. 47025 & 47027 in Mara Township (now Ramara Township).
- 3) Ambient dustfall concentrations are 1992 mean recordings from the following closest monitoring stations: No. 45007 at Ajax; No. 45025 at Oshawa; No. 48002 at Stouffville.

